Atomic Chains: From Low-Dimensional Electrons to the Limits of Data Storage

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One-dimensional physics is particularly elegant because of its mathematical transparency. However, it is not easy to realize a one-dimensional system experimentally. Recently, it has become possible to produce chains of atoms at silicon surfaces by self-assembly. Angle-resolved photoemission reveals exotic band structures and Fermi surfaces, including a fractional electron count of 8/3 that is explained by a low-dimensional version of the doping in HiTc superconductors. These structures can be used as atomically-precise tracks for a memory where a bit is stored by the presence or absence of a single silicon atom. This toy memory is used to test the fundamental limits of data storage and to see how well storage in silicon compares to storage by DNA. Future plans are for a molecular memory, where a bit is stored in a bi-stable molecule.